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Research Article

Extent of Application of Risk Management Practices in China's Agricultural Industry: Regional and Product-Based Differences

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Abstract
This study assesses the extent to which risk management practices are applied across five dimensions in China's agricultural industry, whether application differs by geographical region and by agricultural product category, and what constrains further improvement. Three hundred producers completed a 25-item questionnaire scored on a four-point Likert scale, and ten took part in semi-structured interviews. Weighted means and one-way analysis of variance were used. All five dimension means fell within the applied range of the scale, from 2.74 for identification to 3.07 for governance, and none reached the fully applied level. Regional grouping produced significant differences on four dimensions and product grouping on three, with measurement and assessment significant only across commodities and governance only across regions. Compliance with national policy was the highest rated of the 25 indicators (3.41) and evaluation of policy the lowest (2.41). Reported constraints concerned resource and capability rather than awareness.

Keywords
Agricultural risk management, Risk governance, Regional heterogeneity, Product-type heterogeneity, China

1. Introduction

Agriculture faces multiple types of risks simultaneously, including climate change, market fluctuations, pests and diseases, etc., all at the same time. Interdependence among these sources, and among the instruments and policies to address them, has been documented in various economies, and thus, a holistic approach to agricultural risk management is adopted instead of hazard-by-hazard treatment (OECD, 2009). China is in a concentrated form of this. Production is distributed across agro-ecological zones with different levels of exposure, and the capacity to absorb losses in different holdings varies; thus, the same hazard causes different damage at the level of the sector.

Hazards are not rare, and there is also more than one kind of hazard. Droughts and floods have repeatedly occurred in the main production areas; typhoons have damaged coastal provinces during the growing season; and temperature fluctuations have caused yield losses for different crops in different places. Pest infestations and plant diseases have added to these pressures, and epidemics of livestock and aquaculture have caused such significant losses that entire supply chains have been disrupted. Price fluctuations in the production and input markets have also occurred; at the same time, changes in government policy have altered the operating environment for producers from season to season.

At the same time, the government has introduced many tools, such as policy-based insurance, fiscal subsidies, disaster relief, and more recently, a digital monitoring system. Based on the province, participation in agricultural insurance can enhance the resilience of producers to risks (Chen et al., 2025). Although such instruments are available, they only provide the necessary conditions for the risk management to be carried out. Whether producers engage in systematic risk management and to what extent that application occurs are not known.

To know whether the conditions for risk management have been met, one must first clarify what that risk management requires. Risk does not have a single formal definition; instead, it refers to the exposure and uncertainty that an individual or group faces in their operations (Holton, 2004). In accordance with the sequence provided in the international guidelines for risk management, this paper will identify and analyse risks, assess them; then deal with risks; finally monitor and review the results to record and report under a governance system that allocates responsibilities and resources (International Organization for Standardization [ISO], 2018). The five correspond to the following sequence: Identification, Measurement and Evaluation; Mitigation; Reporting and Monitoring; and Governance.

The two views are the foundations for analysing these attributes. The producer is concerned about the extent of exposure, available resources and expected returns under a particular practice. Other factors in the environment for producers' work include national policies on agricultural risk management, subsidy conditions, insurance arrangements and reporting obligations; all of these restrict the choices available to individuals. The five dimensions are at different degrees of exposure to the latter influence, and this difference will be taken into account in the analysis shown below.

Most of the empirical studies in China on agricultural risk management have been conducted in a single area. Research on adaptive behaviour in one area explores how producers respond to the environment in which they operate and also determines whether these reactions differ according to perception, available resources or access to support systems (Song & Zhu, 2025). Research limited to a single province and a single crop can isolate the reasons for a particular behaviour precisely (Xia &

Guo, 2026). Both designs are suitable for the questions they aim to answer.

Neither design can determine the source of the variations in risk management practice because a study conducted in a single area cannot distinguish whether the results are due to the area or the commodity being studied. Comparatively few studies have tested both grouping variables on the same sample. In the absence of others, it is unknown whether the observed differences are due to agro-ecological factors, hazards in the production of commodities, or institutional arrangements for both. Policy makes different divisions based on areas, and interventions target different groups of people by commodity and are administered differently by the government.

This study determines the scope of application for risk management across the five dimensions in China's agricultural industry, investigate whether there are differences in application based on producer groupings and geographical regions or types of agricultural products, and identify constraints that have been reported to limit further improvement. It tests both grouping variables on the same sample, and the two axes of variation can be directly compared rather than inferred from studies conducted under different circumstances.

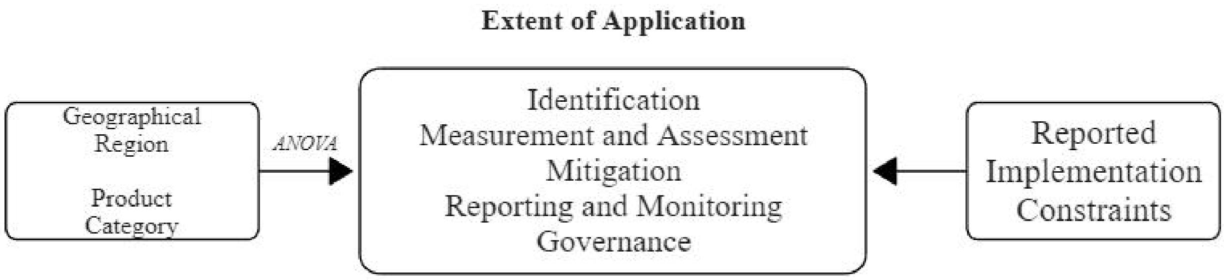
2. Data and Methods

2.1. Research Design

A descriptive quantitative design was employed in this study and supported by qualitative interview data. The object of inquiry is the level at which established practices are implemented, rather than the outcome of any intervention; thus, description is a more suitable approach than causal analysis. The third of the above questions is covered by interviews, and the accounts provided by producers are more informative than scaled responses. Figure 1 is the framework of this study.

Figure 1

Conceptual Framework of the Study



Note. The framework arranges the five risk management dimensions along the vertical axis and the two grouping variables, geographical region and agricultural product category, along the horizontal axis. Arrows denote the comparisons tested by analysis of variance. Reported implementation constraints are shown as factors bearing on the levels of application observed.

2.2. Population, Sampling, and Grouping Variables

Three hundred producers of crops, livestock and poultry, aquaculture, fruit and vegetable farming, etc., from several areas across China participated in the survey. Ten producers from the same group participated in semi-structured interviews. Convenience sampling was employed to collect the data; thus, the questionnaire was distributed through WeChat to the rural producers.

The two grouping variables for the comparative analysis are the geographical area of the holding and the category of agricultural products produced. Both were gathered as category data in the questionnaire. The original documentation does not indicate how many respondents belonged to each category, and it also lacks demographic data for the sample other than what is required to determine its eligibility for the items used. This limits the range of application for the analysis of variance presented below.

2.3. Instrument, Measurement Scale, and Validity

A standardised questionnaire served as the main tool. Twenty-five items were divided evenly among the five dimensions, and five indicators per dimension were created, each phrased as a statement about a particular practice. The four options of the Likert scale did not include a middle neutral point. Table 1 shows the scale, the range of the corresponding mean and the interpretation of each band.

Table 1

Four-Point Likert Scale and Interpretation of Mean Ranges

Scale	Mean range	Description	Interpretation
4	3.26–4.00	Strongly agree	Fully applied
3	2.51–3.25	Agree	Applied
2	1.76–2.50	Disagree	Partially applied
1	1.00–1.75	Strongly disagree	Not applied

A small number of people filled out the questionnaire first to check the clarity of the items and the coverage of each dimension. Content validity refers to how well the items align with the five-dimension framework listed above. No internal-consistency coefficients were calculated in the initial data collection, and therefore none are presented here.

2.4. Data Collection and Ethical Considerations

Voluntary participation at all times. Prospective respondents were informed about the purpose of the study and how the data would be used prior to completing the questionnaire, and their consent was thus obtained. Responses were recorded without personal information, and no item allowed for the identification of individuals. The interviewer said that some questions could be omitted, and they would not be penalized for leaving early. In accordance with the ethical regulations of the institution that carried out this study, it was conducted.

2.5. Analytical Procedures

Weighted means were calculated for each indicator and for each dimension, and then all the means were compared with the bands in Table 1. One-way ANOVA was used to determine if there were any differences in the scores of the dimensions among the groups, and a significance level of 0.05 was set. Report F values and their corresponding probabilities. No post hoc multiple comparisons were performed, and thus it could not be determined which categories were different. Thematic organisation of interview data.

3. Results

3.1. Extent of Application Across the Five Dimensions

Table 2 summarises the weighted means obtained for the five risk management dimensions, together with the highest and lowest rated indicator within each. All five dimension means fell within the Applied band, spanning a narrow interval from 2.74 to 3.07. The dimensions are presented in the order of the operational framework rather than by rank, so that the sequence of the risk management process is preserved.

Table 2

Extent of Application of Risk Management Practices by Dimension

Dimension	*M*	Interpretation	Highest rated indicator	Lowest rated indicator
Identification	2.74	Applied	Pest and disease early warning (3.10)	Evaluation of government policies (2.41)
Measurement and assessment	3.00	Applied	Estimation of climate related losses (3.20)	Structured analytical tools (2.80)
Mitigation	2.92	Applied	Crop and livestock diversification (3.38)	Biosecurity protocols (2.42)
Reporting and monitoring	2.86	Applied	Annual evaluation of strategies (3.10)	Structured reporting to authorities (2.60)
Governance	3.07	Applied	Compliance with national policies (3.41)	Adequacy of governance structures (2.80)

Note. N = 300. Each dimension comprises five indicators. The table summarises the extreme values within each dimension; intermediate indicators are reported in the text where they bear on interpretation. Interpretation follows the bands specified in Table 1.

Risk identification had the lowest mean of the five (M = 2.74). The early warning system for pest outbreaks and diseases had the highest rating in this dimension (M = 3.10), followed by the monitoring of weather patterns (M = 2.89). Assessment of market trends and price fluctuations had a significantly lower rating (M = 2.56), and the evaluation of government policies affecting agricultural production was the lowest (M = 2.41), being the only indicator in this dimension to fall in the partially applied range. Recognition of biological and climate-related risk sources was therefore ranked higher than that for economic and regulatory risks.

Measurement and assessment produced the second-highest dimension mean (M = 3.00) among the five, and among these, it also had the narrowest internal range of the indicators (0.40). Estimation of potential financial losses caused by climate events was rated the highest (M = 3.20), and the classification of risks by severity and likelihood followed closely (M = 3.05). Dependence on historical records for the assessment of prior exposure was rated slightly lower (M = 2.95), and the application of organised analytical tools such as SWOT analysis or probability models received the lowest rating (M = 2.80). All the indices in this group were in the Applied range.

Mitigation had a mean of 2.92 for the dimension and the largest internal range in the study (0.96). Diversification of crops and livestock reached the Fully applied band (M = 3.38), and the adoption of climate-resilient varieties and drought-resistant technology was also relatively high (M = 3.10). Insurance coverage received a relatively low score (M = 2.67), and adherence to biosecurity measures for disease outbreaks in livestock and aquaculture was in the "partially applied" range (M = 2.42). Therefore, this dimension has combined one of the top two rated indicators and one of the bottom two rated indicators among the 25 items.

Reporting and Monitoring had a dimension mean of 2.86. The top two highest scores for the annual evaluation of risk management effectiveness and the maintenance of records of previous incidents were 3.10 and 3.01, respectively. Use of digital platforms for real-time tracking was rated lower (M = 2.80), as was the regular update of strategies in light of new information (M = 2.77), and the presence of a structured system for reporting risks to authorities or institutions received the lowest score (M = 2.60). Retrospective evaluation within the farm thus ranked higher than both continuous monitoring and outward-facing institutional reports.

Governance had the highest dimension mean (M = 3.07). Compliance with national agricultural risk management policies and regulations had the highest score across all indices in the entire study (M = 3.41, fully applied), followed by receiving governmental or institutional support (M = 3.22). Clarity of the procedures for obtaining disaster-related financial aid was relatively low (M = 2.90), and the adequacy of support provided by cooperatives, insurers and other governance structures was the lowest in that dimension (M = 2.80). Reported compliance with policy was therefore significantly higher than the reported adequacy of the structures for support delivery.

Across the 25 indicators, two entered the Fully applied band and two fell into the Partially applied band, leaving 21 within the Applied band and a full range of 1.00 between the extremes. Application consequently clustered around the middle of the scale rather than separating into strong and weak extremes.

3.2. Differences Across Geographical Regions

Table 3 reports the one way ANOVA results obtained for both grouping variables. Regional grouping produced significant differences on four of the five dimensions. Identification (F = 4.12, p = .014), mitigation (F = 6.98, p = .003), reporting and monitoring (F = 3.45, p = .038) and governance (F = 5.21, p = .009) all varied across regions, with mitigation yielding the largest F value and the smallest p value observed on this axis. No significant regional variation was detected in the measurement and assessment dimension (F = 2.03, p = .071), which stood apart from the other four on this axis.

Table 3

One Way ANOVA Results by Geographical Region and Product Type

Dimension	Region F	Region p	Product F	Product p
Identification	4.12	.014*	3.65	.029*
Measurement and assessment	2.03	.071	5.87	.021*
Mitigation	6.98	.003*	4.74	.016*
Reporting and monitoring	3.45	.038*	2.31	.082
Governance	5.21	.009*	1.89	.147

Note. N = 300. Post hoc multiple comparisons were not conducted. *p < .05.

3.3. Differences Across Product Types

Table 3 shows the corresponding results for each category of agricultural products. Grouping on this axis showed significant differences in the three dimensions. Identification (F = 3.65, p = .029), measurement and assessment (F = 5.87, p = .021), and mitigation (F = 4.74, p = .016) all differed significantly across the categories, and measurement and assessment had the highest F value in this group.

No significant variation across product categories was detected in reporting and monitoring (F =

2.31, p = .082) or in governance (F = 1.89, p = .147). Governance produced the smallest F value and the largest p value of any test conducted in this study.

The two groups had different patterns of the grouping variables. Measurement and assessment varied according to the type of product but not by region; reporting and monitoring and governance varied according to the region but not by the type of product. Only the two factors of identification and mitigation showed significant differences on both axes. Therefore, it can be inferred that different sources of variation in risk management practice exist at different levels of the framework and are not uniform throughout.

3.4. Constraints Reported in Implementation

The ten interviewees reported the same set of limitations on the application of risk management in their work. Due to the absence of real-time data and monitoring, decisions on how to deal with the pest outbreak, changes in weather, market fluctuations, etc., could not be made promptly based on current information. Financial constraints limited investments in insurance, resilient infrastructure and monitoring equipment for smaller operations. No standard assessment procedures existed at the smaller operations, so regular evaluation was mostly confined to the larger ones.

Constraints in the institutional environment were also reported. Enforcement of biosecurity measures varied by enterprise size. Support policies were to be implemented differently in various areas, and therefore, the entitlement that should have been available in principle was not realised in practice. The participants also reported having a limited ability to operate the digital risk management tools, and thus access to a platform did not guarantee its use. These accounts are in line with the behaviour that received the lowest rating in this study.

4. Discussion

4.1. A Consistently Moderate Level of Application

No dimension reached the Fully applied band, and the interval between the highest dimension mean and the lowest was small. This pattern suggests that the constituent stages of the risk management process are applied across China’s agricultural industry, but no stage is implemented in full depth; this difference can be seen in the distribution shown in Table 2. A systematic review of socialised service provision in smallholder systems reports a similar arrangement, where the scope of provision has expanded at a faster rate than the ability to measure its impact (Zeng et al., 2025). Therefore, the diagnosis of this sector will focus less on what is missing and more on why none of them has gone further.

4.2. Sources of Variation Differ by Dimension

The two groups of grouping variables are not symmetrical and thus provide more informative results for this study. One possible reason for the regional pattern is that the four dimensions varying among different areas are determined by factors outside the control of individual producers, such as climate exposure, infrastructure, local fiscal capacity and administrative coverage; none of these factors can be controlled by the individual and they differ significantly among agricultural areas in China. A national meta-analysis of adaptation behaviour shows that the motivating factors for farm-level responses to climate risk are also geographically dispersed (Huang et al., 2024). Risk assessment, on the other hand, consists mainly of cognitive routines that are reproducible in any environment, as estimating a loss, ranking hazards by severity and drawing upon prior experience all require judgment rather than external provision. This attribute may be the reason for the absence of a regional difference at this level.

The product axis reverses the above arrangement. The lack of detected variation in the institutional layer is consistent with coercive isomorphism, and thus organisations under the same regulatory authority converge on similar structures regardless of their technical activities (DiMaggio & Powell, 1983). Policy-based insurance in China has national-level standardised eligibility rules and reporting requirements for all commodities (Li et al., 2025), and thus these particular dimensions are likely to be homogeneous. The operational layer still needs to be customised according to the hazard characteristics of different agricultural products because the origins of the risk, its occurrence frequency, and corresponding countermeasures for aquaculture, livestock farming and horticulture are all different. Specialised insurance instruments have emerged in response to this heterogeneity (Hou & Wang, 2024), and thus the divergence observed here may be due to the structure of agricultural risk itself rather than an uneven spread of a common practice.

4.3. Compliance Without Evaluation

The largest gap among the 25 indicators separated two policy-related items. Compliance with national risk management policies received the highest score among all in this study (M = 3.41), and evaluation of government policies affecting operations received the lowest score (M = 2.41). Therefore, the producers are more likely to meet the requirements of the authorities than to think about how those demands will change their work. The two are not the same; one is probably related to whether one is eligible for assistance, and the other can foresee risks caused by policy changes. Evidence of the adoption of green technology shows that the capacity to obtain and interpret policy information functions as an independent determinant of farm-level behaviour rather than a result of a willingness to comply (Liu et al., 2025). Biosecurity was the second weakest indicator, and due to the long-term investment without quick returns, smaller operations maintained these protocols less consistently (Wang et al., 2023).

4.4. Implications and Limitations

The constraints reported by the participants are deficiencies in resources and abilities, not a lack of awareness. Therefore, targeted interventions that address the particular issue are expected to be more effective than general-purpose programmes. Support for the operational dimension can be reasonably divided by area and product, but no change was detected at the institutional level; therefore, attention should be paid to accessibility rather than design. Simplify and target the dissemination of policy information to address the evaluation deficiency mentioned above. Extend the coverage of risk-transfer instruments to smaller enterprises to address the financial constraints reported by participants, and such instruments can protect producers from losses in similar circumstances (Wang & Zhong, 2025). Provide training for the use of the digital monitoring tools; otherwise, they will not be used continuously after being introduced (Yu et al., 2024).

Some limitations qualify these interpretations. Convenience sampling and self-report data have limitations in generalisability. Internal consistency was not reported, and the size of the per-group samples and demographic information were also unavailable. Post hoc tests were not carried out, and thus the particular groups responsible for the significant results could not be identified. The interview topics were summarised without counting how often each was raised. Therefore, the above explanations are interpretive in nature and not demonstrative.

5. Conclusion

This paper studies the level of risk management application in five areas of China's agricultural industry, whether there are different levels of this application among groups of producers in different areas or for different types of agricultural products, and what constraints have been reported that limit further improvement. All the dimension means fell within the Applied band, from 2.74 for identification to 3.07 for governance, and none reached the Fully applied level. Of the 25 indicators, 21 are in the same mid-range. Therefore, the sector has a risk management process for all five areas, but it is shallow in depth; the breadth of application has exceeded the intensity of implementation.

Variation was particular to each dimension and not general. Regional grouping showed significant differences in four dimensions and product grouping in three, and the two sets did not overlap. For measurement and evaluation, no difference was detected across areas, and although reporting and monitoring and governance varied by region, no commodity differences were detected. Therefore, the dimensions closest to the institutional level showed the least sensitivity to what is produced, and identification and mitigation, which are close to daily operations, differed significantly in both dimensions. The largest gap observed anywhere in the study was between compliance with national policies and the evaluation of those policies; thus, it appears that regulatory requirements are met but their effects on the farm have not been assessed. The constraints reported by the participants related to what producers can obtain and operate, rather than what they believe is necessary.

Based on the above, it is concluded that uniform national programmes are not suitable; instead, targeted interventions will be employed. Different areas and goods have different kinds of operational support requirements, and the dimensions shaped by national arrangements demand a different response: instead of focusing on how the policy and support are designed, one should consider how they reach the holdings. The interpretations presented here are based on descriptive comparisons, and to verify them, stratified sampling and post-hoc tests that can pinpoint the particular groups of the observed differences would need to be used.

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Data availability

No data availability statement is required.

Declarations

Conflict of interest

The authors declare that there is no conflict of interest.

Ethics approval

Not applicable.

Consent to participate

Not applicable.

Consent for publication

All authors have given their consent.

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